OPERATION AND SERVICE MANUAL

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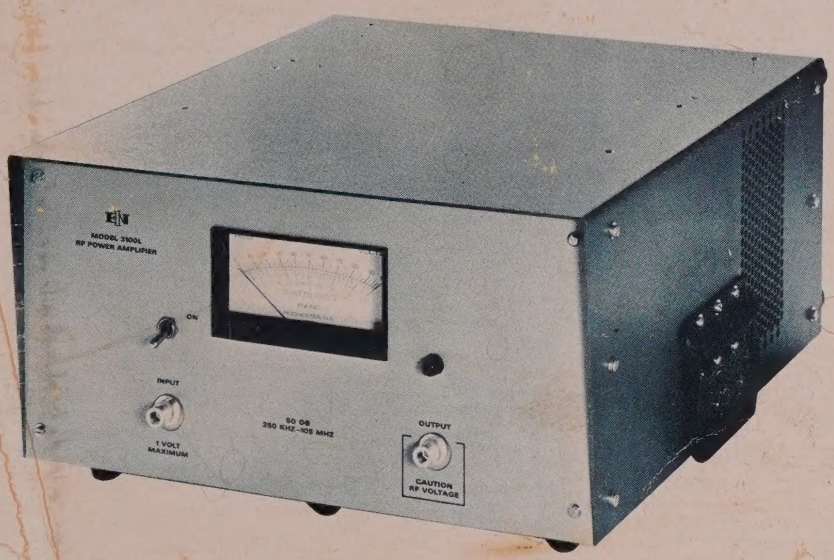

3100L BROADBAND POWER AMPLIFIER

MP MASTER
MA27874

ELECTRONIC NAVIGATION INDUSTRIES Inc.

ROCHESTER, NEW YORK, U. S. A.

WARRANTY

Electronic Navigation Industries, Inc. warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing and replacing any defective parts for a period of one (1) year after delivery to the original purchaser.

When warranty service is required, the instrument must be returned transportation charges prepaid to the factory or our authorized service facility. If, in our opinion, the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before work is started.

There are no other warranties expressed or implied, including any warranty of merchantibility or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

FACTORY SERVICE

When Factory Service is required, the following steps should be taken:

(1) Notify ENI, giving full details of the difficulty. Include the instrument's serial number.

(2) Upon receipt of shipping instructions, forward the instrument, transportation prepaid, to the factory or to the authorized repair station indicated on the instructions.

If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

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CHAPTER 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

The ENI Model 3100L is an all solid state amplifier which has a flat frequency response from 250 kHz to 105 MHz. It provides 100 watts of linear power with low harmonic and intermodulation distortion. Gain is 50 dB nominal, with a variation of less than $\pm$1.5 dB over the entire frequency range. Input and output impedance are 50 ohms and the unit may be driven to full power output by most RF synthesizers, signal generators and swept signal sources.

The ENI Model 3100L will deliver its rated power output into any load impedance, regardless of match. Built-in protection circuitry will absorb the power reflected from a mismatched load without causing failure or oscillation.

Output RF voltage is displayed on the front panel meter. The Model 3100L is packaged for bench mounting and is shipped with rack mounting adapters. Its integral power supply and cooling operate from a 115 or 230 VAC 50/60Hz main supply.

The Model 3100L will raise the power level of signal sources and generators without requiring tuning or band-switching. The Class A linear circuitry will amplify signals of AM, FM, SSB, TV and complex modulations limited only by their peak input and bandwidth, with minimum distortion.

1.2 SPECIFICATIONS

Physical and electrical specifications are listed in table 1-1.

1.3 INSTRUMENT IDENTIFICATION

Each amplifier is identified by a serial number tag on the back panel of the unit. Both the model number and the serial number should be given in any correspondence with the company.

Table 1-1. 3100L Specifications

FREQUENCY COVERAGE:	120 kHz to 120 MHz
GAIN:	50 dB nominal
GAIN VARIATION:	±1.5 dB from 250 kHz to 105 MHz
MAXIMUM POWER OUTPUT:	More than 100 watts from 250 kHz to 105 MHz. More than 50 watts from 120 kHz to 250 kHz and 105 MHz to 120 MHz
HARMONIC DISTORTION:	All odd harmonics more than 25 dB below main signal, at 75 watts output: All even harmonics more than 30 dB below signal at 100 watts output.
TYPICAL 3rd ORDER INTERMODULATION INTERCEPT POINT:	+59 dBM
INPUT/OUTPUT IMPEDANCE:	50 ohms
INPUT VSWR:	Less than 1.5
OUTPUT VSWR:	Less than 2.0, 250 kHz to 80 MHz; less than 3.0, 80 MHz to 120 MHz (typical)
NOISE FIGURE:	Less than 10 dB
STABILITY:	Unconditionally stable, unit will not oscillate for any condition of load and source impedance
PROTECTION:	Unit will withstand up to 13 dB of overdrive (input signal of 1 volt RMS) for all output load conditions, including short and open circuit loads
OUTPUT METERING:	Average reading voltmeter calibrated in RMS volts for a sine wave, with an accuracy of ±3% of full scale (0-100 volts); also calibrated in watts into 50 ohms (0-200 watts).
POWER REQUIREMENTS:	105-125 VAC or 210-250 VAC, 50-60 Hz, 1100 watts.
OPERATING TEMPERATURE:	0° to 40°C.
SIZE:	8 3/4 x 17 x 17 inches
WEIGHT:	69.5 lbs.
CONNECTORS:	Type N

CHAPTER 2

PREPARATION

2.1 INITIAL INSPECTION

2.1.1 Mechanical Check

If damage to the shipping carton is evident, request the carriers agent be present when the instrument is unpacked. Check the equipment for damage and inspect the cabinet and panel surfaces for dents and scratches.

2.1.2 Claim for Damage

If the Model 3100L is mechanically damaged or fails to meet specifications upon receipt, notify ENI or our representative immediately. Retain shipping carton and packing material for the carriers inspection as well as for subsequent use in returning the unit if necessary.

2.1.3 Performance Check

The electrical performance of the Model 3100L should be verified as soon as possible after receipt. Following is a performance check that is suitable for incoming inspection.

a. Set the amplifier front panel power switch to the ON position, and check that the pilot light illuminates and the fan motor is operating normally.

b. Perform RF output power test section 5.1.4.

2.2 PREPARATION FOR USE

2.2.1 Power Requirements

The Model 3100L is factory wired for 115 VAC for delivery in the USA and 230 VAC for foreign delivery. Selection of the proper operating voltage is made by connecting the line cord and jumpers to the correct terminals of strip TB-1 in accordance with table 2-1.

Terminal strip TB1 is mounted on the baseplate at the rear of the Model 3100L and is accessable by removing four (4) #6-32 screws from the rear panel and sliding it straight out.

Disconnect the line cord from the power main when adjusting the operating voltage. Failure to connect jumpers in their proper positions may result in damage to the instrument.

Table 2-1. Line Voltage Connections

LINE VOLTAGE	LINE HOT	LINE COM.	JUMPERS BLUE	JUMPERS RED
107.5	4	1	1-2	3-4
115	6	1	1-2	5-6
120	8	1	1-2	7-8
215	4	1	2-3	Remove
230	6	1	2-5	Red
240	8	1	2-7	Jumper

2.2.2 Power Cable Ground Protection

To protect operating personnel, the ENI Model 3100L is equipped with a three conductor cable and plug which, when inserted in a three terminal receptacle, grounds the panel and cabinet. The offset pin on the power cable three prong-connector is the ground pin. When using a two prong adapter, connect the green pigtail on the adapter to ground.

2.2.3 Cooling

When the 3100L is enclosed by an external cabinet, provisions must be made to insure an adequate flow of cooling air to the unit. Ambient temperature of the air must not exceed 40^{o}C.

2.3 RACK MOUNTING

In order to install the Model 3100L in a standard 19 inch relay rack, rack mounting brackets must be attached to the cover as follows:

a. Remove the Model 3100L cover (see section 6.4.3).

b. Remove the side handles which are held by six #8-32 screws and hardware per handle.

c. Replace the cover and its hardware with the exception of the three #8-32 screws located at each side of the cover nearest the front panel.

d. Verify left and right rack mounting brackets by holding them next to the screw holes. Mounting bracket overhang should be at the bottom of the unit.

e. Attach mounting brackets to the sides of unit by inserting the screws removed in step C through the brackets.

f. Tighten all screws carefully, assuring that the unit is held firmly in place.

g. The six rubber feet on the base plate may be unscrewed and removed if the minimum vertical usage of the relay rack is necessary.

2.4 PACKAGING FOR RESHIPMENT

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container. If a cardboard carton is used it should be at least 200 lb. test material. Use shock absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. A minimum of two inches should be between the instrument and the container wall on each side. Protect the front panel and meter by means of cardboard spacers inserted between the front panel and the shipping carton. Make certain that the instrument cannot move in the container during shipment. Seal the carton with a good grade of shipping tape and mark the container FRAGILE ELECTRONIC INSTRUMENT.

CHAPTER 3
OPERATION

3.1 FUNCTIONAL DESCRIPTION

The ENI Model 3100L is a linear class A amplifier capable of increasing the output of any signal generator, frequency synthesizer, sweep generator or laboratory signal source from 250 kHz to 105 MHz.

Less than 200 millivolts of signal is required from the output of the signal source into the 50 ohm input of the amplifier to extract maximum power output. The output power of the 3100L is directly proportional to the input signal and therefore, the attenuator of the signal generator will serve as the attenuator for the overall output.

The Model 3100L is completely protected against damage due to load mismatch provided that the input RF level does not exceed 1 volt RMS or 1.4 volts peak. If the attached signal source is capable of generating substantially more than this input voltage, please use caution in adjusting it. The Model 3100L will saturate well before the maximum input voltage and there will be no increase in output power at that point.

The 3100L is unconditionally stable. Any impedance can be connected to the input and output of the amplifier, without causing oscillation.

The 3100L will deliver its rated power to any load impedance regardless of match. Load mismatch will cause RF power to reflect back to the amplifier. The unit is designed to withstand 100 percent reflected power (a pure reactance, open or short circuit load will cause 100 percent reflected power) continuously without damage.

An output meter is provided to indicate the average output voltage (calibrated in RMS) as well as the power output when the unit is connected to a 50 ohm load. Since the meter responds only to average output, the modulation characteristics of the input signal must be taken into account when interpreting the meter readings. For example, the amplifier may be in saturation during the on portion of a pulse yet the meter reading will be low due to the low duty cycle of the pulse input.

3.2 CONTROLS, INDICATORS AND CONNECTORS

Front and rear panel devices are described in table 3-1.

3.3 OPERATING PROCEDURE

Refer to the following procedure as a guide to operating the Model 3100L.

a. The input and output are connected via the front panel type N connectors to the signal source and load respectively.

b. The input signal should be increased gradually while observing the output voltage on the output RF voltmeter. Input signal voltage should never be allowed to exceed 1 volt (RMS) or 1.4 volts (peak).

c. When the Model 3100L is connected to a 50 ohm load, the CW power output of the unit may be read directly from the meter scale.

d. When the amplifier is connected to an arbitrary or unknown load impedance, the following procedure will insure low distortion power output.

   1. Disconnect the output load cable from the output type N connector of the Model 3100L.

   2. If the CW output voltage is less than 100 volts RMS, the unit is operating at low distortion regardless of the load impedance.

   3. Reconnect the output of the amplifier to the load.

e. If the output of the amplifier is monitored by a high frequency oscilloscope or spectrum analyzer, the input signal may be increased until the point of maximum undistorted power output is observed.

Table 3-1 Front and Rear Panel Devices

DEVICE	FUNCTION
Power Switch	Throwing toggle to "on" position connects fan and power supply to main power source.
Meter	Indicates output voltage and also power for a 50 ohm load. The meter circuit responds to the average RF voltage and is calibrated in RMS volts for a sine wave. The voltage pick-off is mounted directly behind the front panel at the output connector.
Input Connector	Type N for connection of the driving generator. Input impedance is 50 ohms. No more than 0.2 volts is required to obtain saturated output. Up to 1.4 volts peak can be applied without causing damage; however, no additional power output can be expected.
Output Connector	Type N for connection of amplifier output to load.
Fuse	Holder requires 3AG size, slow-blow type fuse of rating to correspond to marking on rear panel.
Line Cord	Three prong type plug with safety ground pin connected to cabinet.

3.4 PRECAUTIONS

a. The Model 3100L output is at DC ground potential through the final combining transformer (see schematic diagram Figure 7-2). Therefore, the output should not be directly connected to a load on which there is a DC potential. A series capacitor with the appropriate DC voltage breakdown rating (.1 mfd is the recommended value) should be inserted between the output connector and the load.

b. The input and output of the Model 3100L should not be connected together. This will cause oscillation and may damage the input preamplifier.

c. The Model 3100L should not remain connected to an antenna when the unit is not in use. If thunderstorms are likely, it would be prudent to earth ground the unit's case.

d. When the input signal voltage of the signal source is unknown, insert an attenuator between it and the Model 3100L input.

CHAPTER 4
PRINCIPLES OF OPERATION

4.1 GENERAL

The Model 3100L achieves its high level of power output by combining the power outputs of a number of individual transistor amplifiers. The hybrid combining technique permits each amplifier to operate independently of all the others and to supply its power output contribution without regard to the other amplifier stages. This isolation is afforded by ferrite loaded transformer hybrids connected at the input and output of each transistor pair.

Each amplifier module (either power amplifier or preamplifier) is designed to have an input and output impedance of 50 ohms. Therefore, the individual modules can be disconnected and tested independently.

Highly linear Class A transistors are used throughout the amplifier. Their linearity is augmented by negative feedback networks connected to each stage. The high power output transistors have nichrome resistors deposited at their emitter terminals to increase linearity and reliability.

The amplifier is powered by a low noise DC regulator of dissipative design. Over temperature protection is built into the power supply and cooling fan.

4.2 BLOCK DIAGRAM DESCRIPTION

A block diagram of the entire Model 3100L is shown in figure 4-1.

Input signal from the front panel Type N connector is fed to the preamplifier module (A27). The preamplifier has eight equal amplitude and phase outputs. These are fed via coaxial cables to the inputs of eight driver amplifier modules (A1). Each preamplifier channel has an overall gain of 13 dB and a maximum power output of 100 milliwatts. The driver amplifier modules are push-pull units capable of supplying up to 3 watts of output, with 20 dB gain. Signal supplied by each driver amplifier is fed to its respective power amplifier module (A21).

Each power amplifier has a gain of 8 dB and is capable of producing more than 15 watts of power at its output. The combiner module (A28) sums the outputs of the power amplifiers while maintaining isolation between them. RF output signal is fed to the output Type N connector and to the RF voltmeter module (A29). The RF voltmeter module provides a DC signal to the front panel meter, proportional to the output level.

The power distribution (3100L-2201) provides cooling and DC power to the entire unit. The regulated power supply is capable of supplying 27.5 volts at a current of 32 amperes.

4.2.1 Preamplifier Module (A27) 3100L-4204

The schematic for the preamplifier module is shown in figure 7-1. Input signal is amplified by a low noise transistor stage Q1. Its output is impedance matched and split into equal phase signals by transformers T1, T2, T3 and T4 and fed to transistors Q2, Q3, Q4 and Q5. Signal boost capacitors C7, C9, C11 and C13 compensate for the gain roll-off of the succeeding amplifier stages. The output signals from transistors Q2 and Q3 are recombined and impedance matched by transformers T5 and T7. The hybrid network consisting of transformers T9, T11, and T12 splits the signal into four equal phase and amplitude signals at J3, J4, J5 and J6. The output signals from transistors Q4 and Q5 are recombined and impedance matched by transformers T6 and T8. The hybrid network consisting of transformers T10, T13, and T14 split the signal into four equal phase and amplitude signals at J7, J8, J9 and J10.

4.2.2 Driver Amplifier Module (A1) 350L-4181

The schematic of the driver amplifier module is shown in figure 7-1. Input signal fed to J11 is matched, split and inverted by transformers T1 and T2. Two equal amplitude, phase reversed signals are fed to the inputs of transistors Q1 and Q2. The outputs of transistors Q1 and Q2 are coupled to the base of power output transistors Q3 and Q4 through matching transformers T3 and T4. Reversing hybrid transformer T5 combines the power outputs of Q3 and Q4 and couples even order harmonics to resistor R2. Transformer T6 matches the output impedance to 50 ohms.

4.2.3 Power Amplifier Module (A21) 350L-4184

The schematic of the power amplifier module is shown in

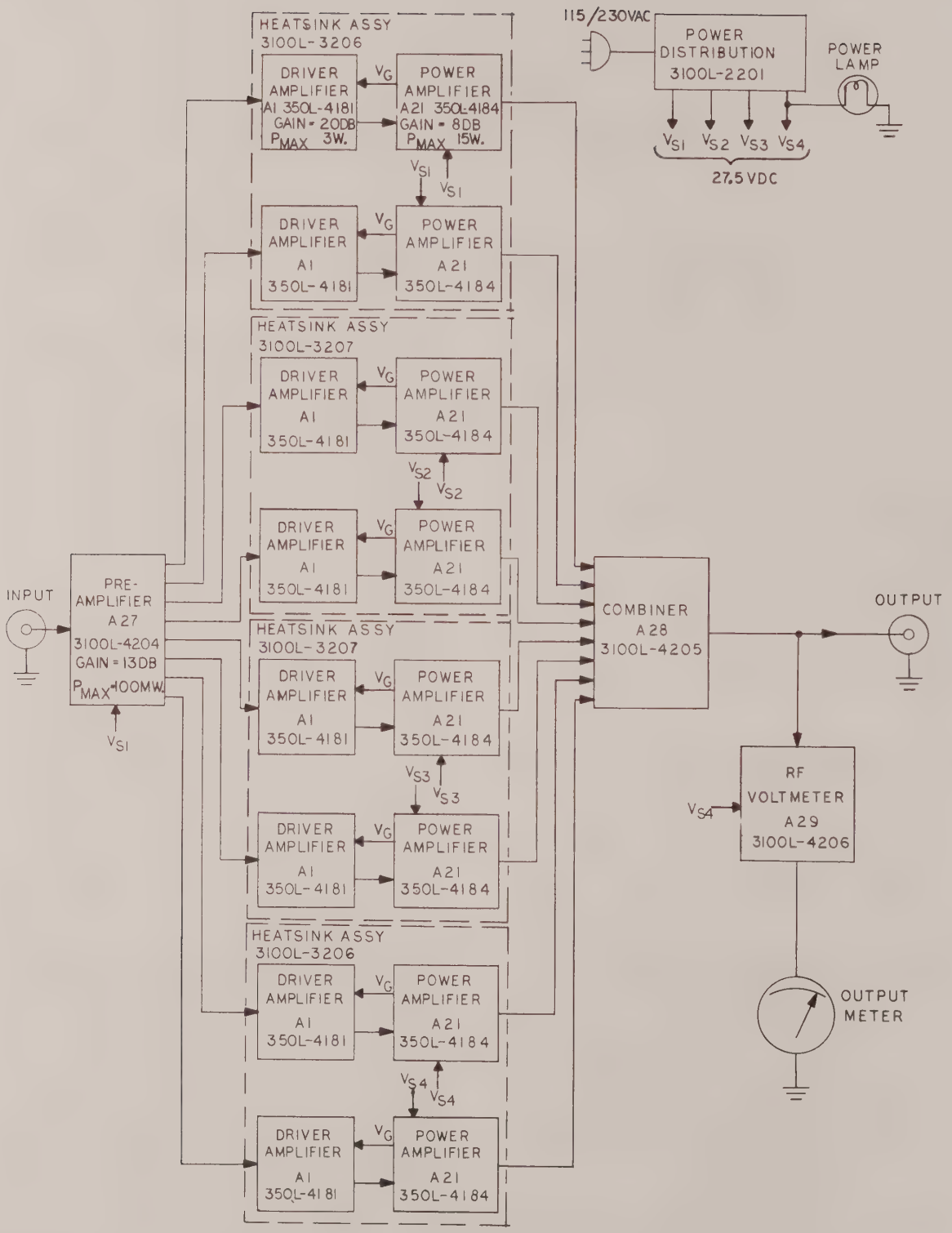


Figure 4-1. 3100L Block Diagram

figure 7-2. Input signal impressed at connector J27 is divided into two equal phase and amplitude signals by transformer T1. Each signal is fed to two identical power amplifier channels. The top channel signal is fed to a phase reversing hybrid consisting of transformers T2 and T3. Transistors Q1 and Q2 amplify the signal by 8 dB and feed their outputs to reversing hybrids T6 and T7. Transformer T10 sums the power outputs of the top and bottom channel and transformer T11 matches the outputs to a 50 ohm load at connector J35.

4.2.4 Combiner Module (A28) 3100L-4205

The schematic of the combiner module is shown in figure 7-2. RF signals impressed at connectors P35, P36, P37 and P38 are summed and impedance matched by hybrid transformers T6, T7, T4 and T2. Capacitors C1, C2 and C3 compensate the winding reactance of transformers T4 and T2. RF signal impressed at connectors P39, P40, P41 and P42 are summed and impedance matched by hybrid transformers T8, T9, T5 and T3. Capacitors C4, C5 and C6 compensate for the winding impedance of transformers T5 and T3. Transformer T1 sums the outputs of transformers T2 and T3 and matches the output impedance to 50 ohms at J43.

4.2.5 RF Voltmeter Module (A29) 3100L-4206

The schematic of the RF voltmeter module (A29) is shown in figure 7-2. Resistors R1, R2, R3 and R4 make up a high impedance voltage divider and are connected to the RF output voltage at the 3100L output connector (J45). A fast switching hot carrier diode CR1 rectifies the RF voltage from the divider. A wire gimmick (capacitor C2) compensates for the high frequency roll-off of the diode CR1. Resistors R4, R5, R6 and capacitor C1 filter the rectified RF and convert it to DC which is fed to the front panel meter.

4.2.6 Power Distribution (3100L-2201)

A schematic of the power distribution is shown in figure 7-3. The AC power is distributed from terminal block TB1 to the power transformer T1. The red and blue jumpers on TB1 allow selection of line voltages for transformer T1 primary (see power connections section 2.2.1). The secondary of T1 supplies voltage to four full wave bridge rectifiers CR1, CR2, CR3 and CR4. The output of each rectifier is connected to capacitors C1, C2, C3, C4 respectively and the collectors of Q2, Q3, Q4 and Q5 located on the transistor assemblies (350L-4188). These transistors form a series pass regulator of the dissipative type. The output of each rectifier is also connected to separate integrated circuit voltage regulators IC-1, IC-2, IC-3 and IC-4 located on the power supply regulator board (A26) 3100L-4203. The voltage output of each supply is adjusted by potentiometers A26R5, A26R6, A26R7, and A26R8.

CHAPTER 5
PERFORMANCE TEST PROCEDURES

5.1 PERFORMANCE TESTS

5.1.1 General

There are three tests required to check the operation and performance of the Model 3100L. These tests are as follows: the gain and gain variation test, the RF output power test and the RF output distortion test.

5.1.2 Test Equipment Required

The following test equipment is required for accomplishing the Model 3100L performance tests. Equivalent substitutes for recommended models may be used.

a. Oscilloscope - Telequipment Model S54A
   - or Telequipment Model D67
   - or Tektronix Model D100 with 5A23N and 5A24N plug-in units.

b. RF Generator/Sweeper - HP-8601A

c. 50 ohm Detector - HP 8471A
   - or Wavetek D151

d. Attenuator, 30 dB, 200 watts - Bird 8322

e. Attenuator, 30 dB - HP-8491A

f. Attenuator, 10 dB, 20 watts - Narda 766-10

g. Calorimetric Power Meter - HP 434A

h. Spectrum Analyzer - HP 140T Display Unit
   - HP 8554L Spectrum Analyzer-RF section
   - HP 8552A Spectrum Analyzer-IF section

5.1.3 Gain and Gain Variation Test

The purpose of this test is to verify the gain and gain flatness versus frequency of the Model 3100L.

5.1.3.1 CALIBRATION OF SET UP

a. Set-up the test equipment as shown in figure 5.1.

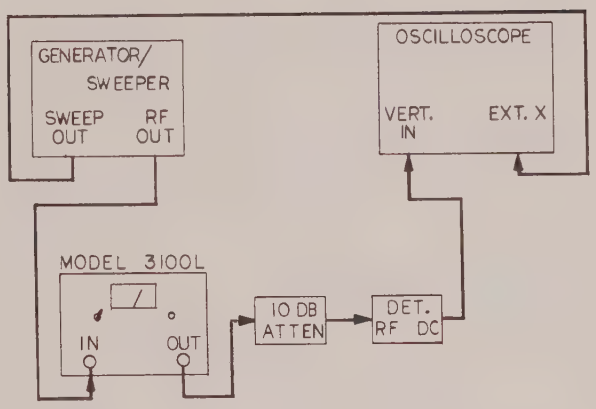


Figure 5-1. Gain and Gain Variation Test Set Up

b. Set oscilloscope to DC, Time/CM to Ext. X, and vertical gain to 10MV/CM.

c. Set the RF Generator/Sweeper to video sweep and frequency to 105 MHz.

d. Disconnect the Model 3100L from the set-up and connect the Generator/Sweeper RF output directly to the 10dB attenuator.

e. Adjust the output level of the Generator/Sweeper for full vertical deflection on the oscilloscope face.

f. Calibrate the scope face to show 3 dB in 1 dB steps by attenuating the Generator/Sweeper in 1 dB steps and marking the traces with a grease pencil.

g. Return Generator/Sweeper output level to full deflection. Rotate the step attenuator on the Generator/Sweeper (CCW) so that the output is reduced by 50 dB.

h. Reconnect Model 3100L into the test set up of figure 5-1.

5.1.3.2 MEASUREMENT PROCEDURE

a. Turn on Model 3100L power switch.

b. Observe the gain versus frequency sweep on the oscilloscope.

1. The average gain should be 50 dB (within 1 dB).

2. The gain variation should be within the 3 dB markings as shown on the oscilloscope face.

5.1.4 RF Output Power Test

The purpose of the RF output power test is to verify that the Model 3100L will deliver more than 100 watts of RF power over the frequency range of 250 KHz to 105 MHz.

5.1.4.1 MEASUREMENT PROCEDURE

a. Set-up the test equipment as shown in figure 5-2.

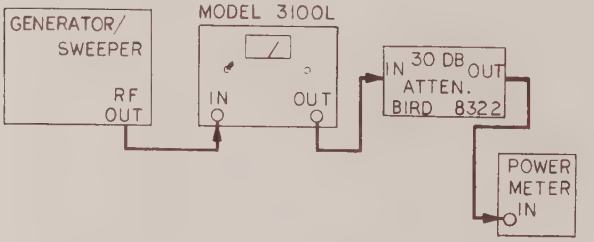


Figure 5-2. RF Output Power Test Set Up

b. Set the calorimetric power meter to the .30 watt range. With the 30 dB series attenuator, this corresponds to a full scale deflection of 300 watts.

c. Set the Generator/Sweeper to CW, output level to +3 dBm and frequency to 250 kHz.

d. Slowly increase frequency while observing the power meter. Note that at every frequency up to 105 MHz, the power output is in excess of 100 watts.

5.1.5 RF Output Distortion Test

The purpose of this test is to verify that the harmonic distortion of the Model 3100L and hence its linearity is within specified limits.

5.1.5.1 MEASUREMENT PROCEDURE

a. Set-up the test equipment as shown in figure 5-3.

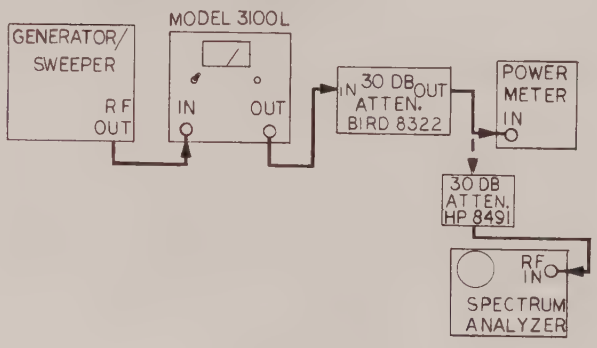


Figure 5-3. RF Output Distortion Test Set Up

b. Set the calorimetric power meter to .30 watt range. With the 30 dB series attenuator, this corresponds to a full scale deflection of 300 watts.

c. Set Generator/Sweeper to CW and frequency to 250 kHz.

d. Adjust the Generator/Sweeper output level so that the output power indicated on the calorimetric power meter is 100 watts.

e. Disconnect the cable from the power meter and connect it to the Spectrum Analyzer through a 30 dB attenuator.

f. Observe that the 3rd harmonic is at least 20 dB below the fundamental and the 2nd harmonic is at least 30 dB below fundamental signal.

g. Repeat steps d. through f with the generator frequency set at 1MHz, 10MHz, 40MHz, and 105 MHz in succession.

CHAPTER 6
TROUBLESHOOTING AND REPAIR

6.1 TROUBLESHOOTING

The first step in isolating a malfunction is to review the conditions under which the symptoms were observed and check that it was not caused by the external cabling or associated test equipment. Before proceeding to the detailed test procedure, a complete visual inspection of the 3100L should be accomplished. Check for burnt or discolored components, loose cable connectors and broken wires and note any details which might localize the malfunction.

Commonly found symptoms together with their probable cause and troubleshooting recommendations are listed in the Troubleshooting Guide, Table 6-1.

Table 6-1. Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
Power lamp does not light	Burned out bulb	Check for 27.5 volts across bulb.
	Defective Power Supply	Perform test in section 6.3.1.1.
	Thermal Switch Open	If TS1 contacts do not close after unit has cooled, replace thermal switch.
	Defective Power Switch	Replace switch (S1).
	Blown Fuse	Replace fuse with 15 amp 3AG S.B.
Power Lamp dim	Power supply out of adjustment	Perform Power Supply Adjustment Section 6.3.1.2.
	TB1 wired incorrectly	Check section 2.2.1.
Blown Fuse	Defective Power Supply	Perform test in section 6.3.1.1.
	Wrong Fuse	Check to see that 15 amp 3AG S.B. is installed.
	Defective line cord or AC wiring	Visually inspect for signs of insulation breakdown.
No RF Output or Gain	Broken input or output Type N connector	Visually inspect connectors for broken pins.
	Defective Input or Output internal cables	Visually inspect cables at input and output connectors.
	Defective Preamplifier Module	Replace Q1 of the preamplifier module (A27) 3100L-4204.

Table 6-1. Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
Low RF Output or Gain	Defective input cables	Visually inspect cables
	Faulty Power Supply Adjustment	Perform Power Supply Adjustment section 6.3.1.2.
	Defective RF Amplifier Module	Perform procedure for Faulty RF module, section 6.2.
Excessive Distortion	Defective Power Amplifier Module	Perform procedure for locating faulty RF module section 6.2.
Amplifier Overheating	Defective Fan	Check that fan is operating properly
	Ambient air is above specifications	Measure the ambient temperature.
	Defective Power Supply	Perform test in section 6.3.1.1.
Incorrect Front Panel Meter Indication	Improper Calibration or defective RF voltmeter board (A29)	Perform RF voltmeter adjustment section 6.2.3.
	Defective Meter	Replace meter
Meter reads up scale with input and output cables removed	Sticking meter movement	Replace meter
	Unit oscillating because of loose or defective internal coax cable connections	Tighten all RF connectors
Excessive ripple on gain versus frequency sweep of amplifier	Ripple on power supply	Perform DC power supply test section 6.3.1.1.

6.2 LOCATING FAULTY RF MODULE

6.2.1 General

The input and output impedance of each of the RF modules in the Model 3100L is 50 ohms. Therefore, they can be disconnected from each other at any point and tested independently. The following section provides a method of locating a faulty RF module. Figure 6-1 through 6-4 shows the location of heatsink assemblies, modules and major components.

6.2.2 Isolating Amplifier Problem

a. Set-up the test equipment as shown in figure 5-2 for RF output power test.

b. Set the Generator/Sweeper to CW, the frequency to 30 MHz and output level to 3 dBm. If the Model 3100L output power is considerably less than 100 watts, as indicated on the calorimetric power meter, a faulty RF module may exist.

c. Disconnect the coaxial cable from J35 of the power amplifier module (A21) and observe the output power of the 3100L as indicated on the calorimetric power meter. The power will drop by 24% (±4%) for a properly functioning power amplifier and driver combination. Reconnect the coax cable to J35 and remove the coax cable from J36. Observe power drop. Repeat identical procedure for J37, J38, J39, J40, J41 and J42.

If the power output drops an equal amount (within 3%) as each cable is removed, the fault is in either the combiner module (A28) or the preamplifier module (A27). Perform tests in section 6.2.2.1 and 6.2.2.2.

If the output power does not drop or drops less than normal, as each of the cables is removed, the fault is in either the driver amplifier module (A1) or the power amplifier (A21) associated with that cable (see section 6.2.2.3).

6.2.2.1 COMBINER MODULE (A28) TEST

a. Set the Generator/Sweeper to CW, frequency to 30 MHz, output level to 0 dBm and connect it to the 3100L input. Connect a 50 ohm, 150 watt load (Bird 8135) to the output of the 3100L. Connect the calorimetric power meter in series with a 10 dB, 20 watt attenuator (Narda 766-10). Set the power meter range to 10 watts which corresponds to a full scale deflection of 100 watts. Connect each power amplifier module (A21) output (J35, J36, J37, J38, J39, J40, J41 and J42) to the attenuator and record their individual output powers.

b. Using the set-up of figure 5-2, measure and record the total output power.

c. The sum of the powers from step a. should be within 15 percent of the total output power recorded in step b. If they are not, the combiner module (A28) is faulty.

6.2.2.2 PREAMPLIFIER MODULE (A27) TEST

If the test in section 6.2.2 shows that the outputs at J35 through J42 of the power amplifier modules (A21) are equal and the combiner module (A28) is not faulty, as shown in section 6.2.2.1, then the preamplifier module (A27) is suspect. A check of the power supply per section 6.3.1.1 should be performed to conclude positively that the preamplifier module is faulty.

6.2.2.3 HEATSINK ASSEMBLY TEST (3100L-3206 AND 3207)

Two tests are required to test a heatsink assembly. They are a bias voltage check and an RF power test. In order to perform these tests the following test equipment is required. Equivalent substitutes may be used for the recommended models.

1. DVM - Fluke 8000A
   - or Fluke 8100A
   - or Weston 1241
2. Generator/Sweeper - HP8601A
3. Calorimetric Power Meter - HP434A
4. Attenuator, 30 dB, 50 watts - Bird 8321
5. Power Supply, Lamda LK-343-AFM
6. Cooling Fan - Rotron Type 113

6.2.2.3.1 Bias Voltage Check

a. Adjust the power supply to 27.5 volts.

b. Connect the power supply minus (—) lead to the heatsink. Connect the power supply positive (+) lead to either inner terminal of TB1 on the heatsink assembly.

c. Position the cooling fan so that the cooling air is directed at the heatsink assembly.

d. Verify the following transistor bias voltages:

Driver Amplifier Modules (A1)

(i) Emitters A1Q1 and A1Q2 - 1.2 to 1.4 volts DC.

(ii) Emitters of A1Q3 and A1Q4 - 3.6 to 3.9 volts DC.

Power Amplifier Modules (A21)

(i) Emitters of A21Q1 through A21Q4 - 3.6 to 3.9 volts DC.

e. If all voltages are within tolerance procede to the RF Power Test.

6.2.2.3.2 RF Power Test

a. Set-up the test equipment as shown in Figure 5-2 with heatsink assembly substituted for the 3100L.

b. Set the Generator/Sweeper to CW, frequency to 105 MHz and output level to +20 dBm.

c. The calorimetric power meter will indicate more than 15 watts for a properly functioning driver and power amplifier combination.

d. If 15 watts is not obtained, remove the calorimetric power meter from the output of the power amplifier (A21), and connect it directly to the output of its associated driver amplifier module (A1). The driver amplifier module should have

more than 2.5 watts of output power. If the driver amplifier module is operating properly, the power amplifier module is faulty.

6.2.3 RF Voltmeter (A29)

The Model 3100L output meter should be accurate to within ± 6 watts of the actual output power. If the meter is out of calibration, the following alignment procedure should be used:

6.2.3.1 ALIGNMENT PROCEDURE

a. Set up the test equipment as shown in Figure 5-2.

b. Set the Generator/Sweeper to CW, and the frequency to 1 MHz. Adjust the output level so that 100 watts is indicated on the calorimetric power meter.

c. Adjust potentiometer A29R6, located on the RF voltmeter module so that the front panel meter indicates 100 watts.

d. Set the Generator/Sweeper to 105 MHz and adjust the output level so that 100 watts is indicated on the calorimetric power meter. Adjust the wire gimmick (capacitor C2) around resistors A29R1 and A29R2 until the front panel meter indicates 100 watts.

6.3 DC POWER SUPPLY

6.3.1 General

The following test and adjustment procedure should be performed after the replacement of the power supply assembly (transistor assembly 350L-4188, power supply regulator board 3100L-4203) or if the power supply voltages are out of adjustment.

The power supply regulator board (A26) is divided into four separate voltage regulators. The far left regulator supplies DC voltage to the left outside heatsink assembly (3100L-3206) and is adjusted by A26R5. The second regulator supplies DC voltage to the left inside heatsink assembly (3100L-3207) and is adjusted by A26R6. The third regulator supplied DC voltage to the right inside heatsink assembly (3100L-3207) and is adjusted by A26R7. The far right regulator supplied DC voltage to the right outside heatsink assembly (3100L-3206) and is adjusted by A26R8.

6.3.1.1 TEST PROCEDURE

a. To test the DC power supply, the following equipment is required. Equivalent substitutes may be used for the recommended models.

1. Digital Voltmeter - Fluke 8000A
   - or Fluke 8100A
   - or Weston 1241

2. Oscilloscope - Telequipment S54D
   - or Tektronix 545

b. Disconnect all external cables from Model 3100L.

c. Connect the minus (—) DVM lead to the chassis and the positive (+) lead to the far left terminal of TB1 on the power supply regulator board (A26). The DVM should indicate between 27.5—27.8 volts DC.

d. Connect the Oscilloscope to the far left terminal on TB1. The 120 Hz ripple on that supply should be less than 50 millivolts.

e. Repeat steps c. and d. for the remaining three terminals on TB1 of the power supply regulator board (A26).

f. If the voltage is not between 27.5 and 27.8 volts, then readjust the supply as indicated in section 6.3.1.2.

6.3.1.2 ADJUSTMENT PROCEDURE

a. Connect DVM minus (—) lead to the chassis and the positive (+) lead to the far left terminal of TB1 on the power supply regulator board (A26).

b. Adjust potentiometer A26R5 until the DVM indicates 27.5 — 27.8 volts DC.

c. Remove the positive (+) lead from the far left terminal and connect it to the inner left terminal of TB1. Adjust potentiometer A26R6 until the DVM indicates 27.5 - 27.8 volts DC.

d. Remove the positive (+) lead from the inner left terminal of TB1 and connect it to the inner right terminal of TB1. Adjust potentiometer A26R7 until the DVM indicates 27.5 - 27.8 volts DC.

e. Remove the positive (+) lead from the inner right terminal and connect it to the far right terminal of TB1. Adjust potentiometer A26R8 until the DVM indicates 27.5 - 27.8 volts DC.

6.4 DISASSEMBLY PROCEDURES

6.4.1 General

The following disassembly procedures describe the recommended method of removing assemblies and printed circuit

modules for the purpose of test, repair, or replacement. Careful handling should be used to avoid damaging the boards.

6.4.2 Tools Required

The Model 3100L is assembled with standard hardware. Screw sizes range from #2-56 to #8-32 and are of the Phillips or slotted types. Standard tools are required for their removal.

6.4.3 Removal of Cover

Remove all screws, (6-#8-32 and 2 # 6-32), located on both sides of the cover and the 8-# 4-40 Phillips head screws located on the top of the cover. Carefully lift the cover up. To replace cover, simply reverse the procedure. When replacing the cover, care should be taken that the cover does not come into contact with the internal amplifier cabling.

6.4.4 Preamplifier Module (A27) 3100L-4204 and Combiner Module (A28) 3100L-4205

a. Remove the four # 4-40 screws holding the preamplifier module to the inner heatsink assemblies (3100L-3207).

b. Remove the eight output cables from the connectors (J3 through J10) on the preamplifier module (A27).

c. Remove the four # 4-40 screws holding the combiner module to the inner heatsink assemblies (3100L-3207).

d. Untie the two cable harnesses and remove the eight cables from the outputs of the power amplifier module (A21) 350L-4184 (P35 through P42).

e. Disconnect the front panel coaxial cables from the input and output BNC connections (J2 and J43) on the combiner module (A28) 3100L-4205.

f. Remove the power supply wire from the terminal block on the power supply regulator board (A26) 3100L-4203.

g. Carefully remove both units from the Model 3100L; they will remain connected together by a coaxial cable.

6.4.5 Power Supply Regulator Board (A26) 3100L-4203

a. Remove the two # 4-40 screws holding the board to the inner heatsink assemblies (3100L-3207).

b. Unsolder the twelve wires (four red, four white and four blue) from the underside of the board.

c. Remove the power supply wires from the terminal block.

6.4.6 Heatsink Assemblies (3100L-3206 and 3207)

a. To remove either of the outside heatsink assemblies (3100L-3206) disconnect the coax cables connected to the inputs of the driver amplifiers module (A1) 350L-4181 (P11 and P12 for left outer and P17 and P18 for right outer).

b. Disconnect the coax cables connected to the outputs of the power amplifier module (A21) 350L-4184 (P35 and P36 for left outer and P41 and P42 for right outer).

c. Remove the five # 6-32 screws from the baseplate for each heatsink assembly.

d. To remove either of the inside heatsink assemblies (3100L-3207), it is necessary to remove the preamplifier module (A27), the combiner module (A28) and the power supply regulator board (A26) per sections 6.4.4 and 6.4.5.

e. Remove the five # 6-32 screws from the baseplate for each heatsink assembly.

6.4.7 Transistor Assemblies (350L-4188)

a. Remove the four heatsink assemblies (two 3100L-3206 and two 3100L-3207) per section 6.4.6.

b. Remove the two # 6-32 screws holding each transistor assembly to the baseplate.

c. Unsolder the four wires (red, white, blue and blue) connected to each transistor assembly.

6.4.8 Driver Amplifier Module (A1) 350L-4181

a. Remove the heatsink assembly (see section 6.4.6).

b. Remove the coaxial cables from the output connector on the drive amplifier (P19, P20, P21, P22, P23, P24, P25 or P26).

c. Remove the two # 4-40 screws holding the driver amplifier to the heatsink.

d. Remove the two # 10 nuts holding the stud mounted transistors to the heatsink.

e. Remove the power supply wire from the inner terminal on TB1.

f. Lift the board from the heatsink carefully removing the two transistors from the heatsink cups.

Note

When replacing stud mounted transistors do not use excessive torque (5 inch pounds maximum).

6.4.9 Power Amplifier Module (A21) 350L-4184

a. Remove the heatsink assembly (see section 6.4.6).

b. Remove the four # 4-40 screws holding the power amplifier module to the heatsink.

c. Remove the coaxial cable from the input connector on the power amplifier module (P27, P28, P29, P30, P31, P32, P33 or P34).

d. Remove the two wires connected to the terminal block.

CAUTION

The red wires connected to the inside terminals of the terminal block TB1 are the 27.5 VDC leads for the power amplifier modules (A21). The red wires connected to the outside terminals are the 25.8 VDC leads for the driver amplifier modules (A1). If these wires are reversed, the power amplifier module can be damaged.

e. Carefully lift the power amplifier module (A21) off the four transistors Q1, Q2, Q3 and Q4.

Note

When replacing the power amplifier module (A21) make sure all four transistors are lined up with sockets before securing board to heatsink.

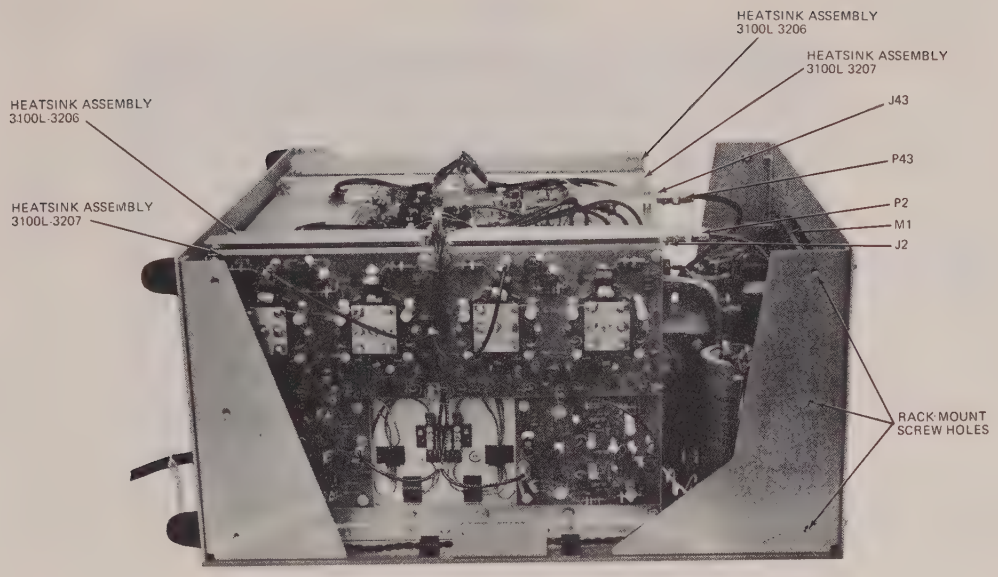


Figure 6-1. Side View, Component Location

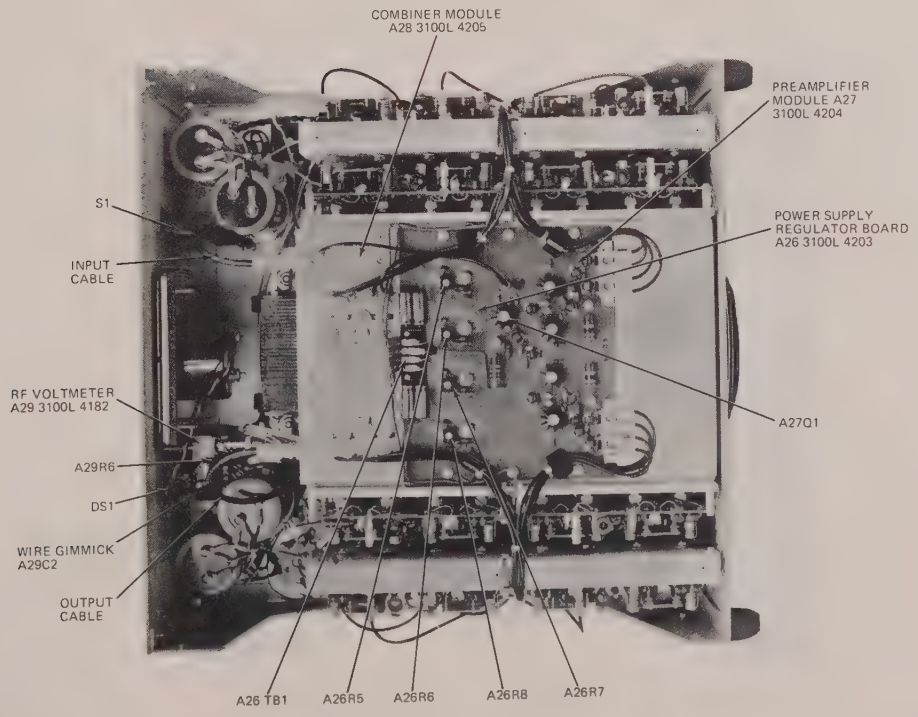


Figure 6-2. Top View, Module and Component Location

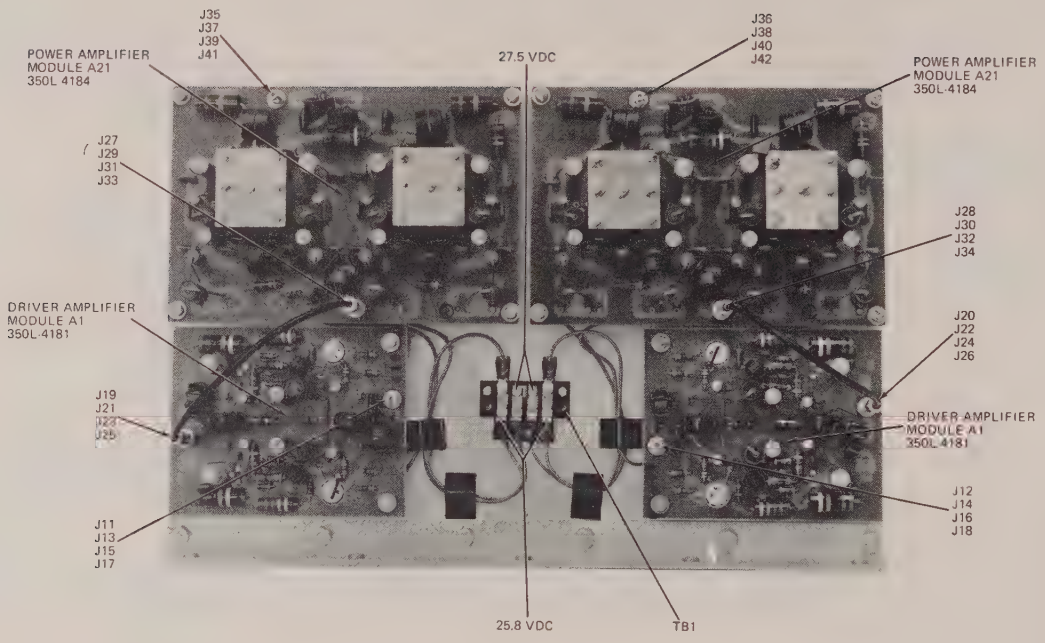


Figure 6-3. Heatsink Assembly (3100L-3206 and 3207)

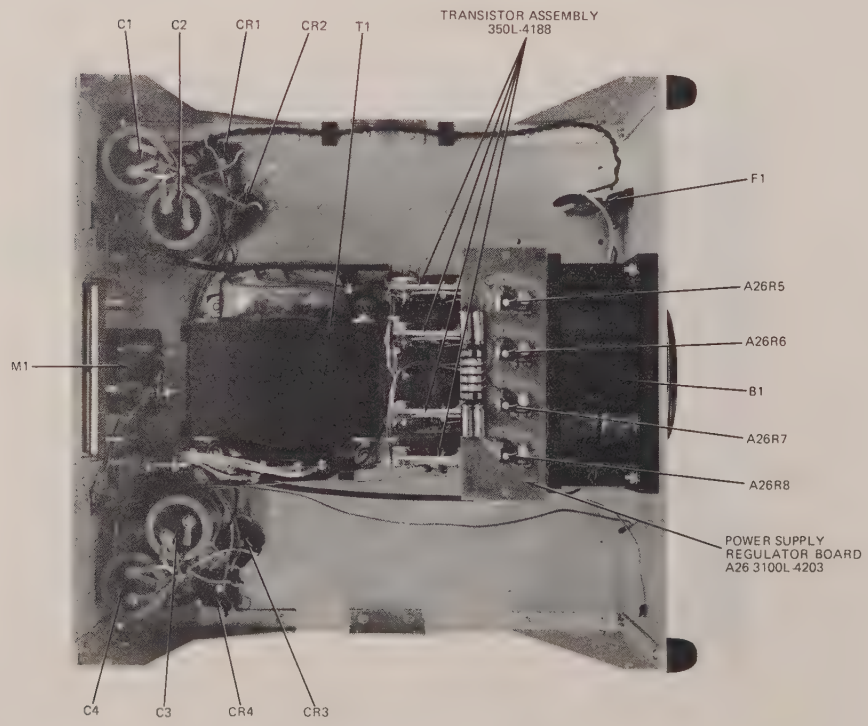


Figure 6-4. Power Distribution (3100L-2201)

CHAPTER 7
SCHEMATICS AND PARTS LIST

7.1 SCHEMATIC DIAGRAMS

Complete schematic diagrams appear in figures 7-1 through 7-3.

7.2 PARTS LIST

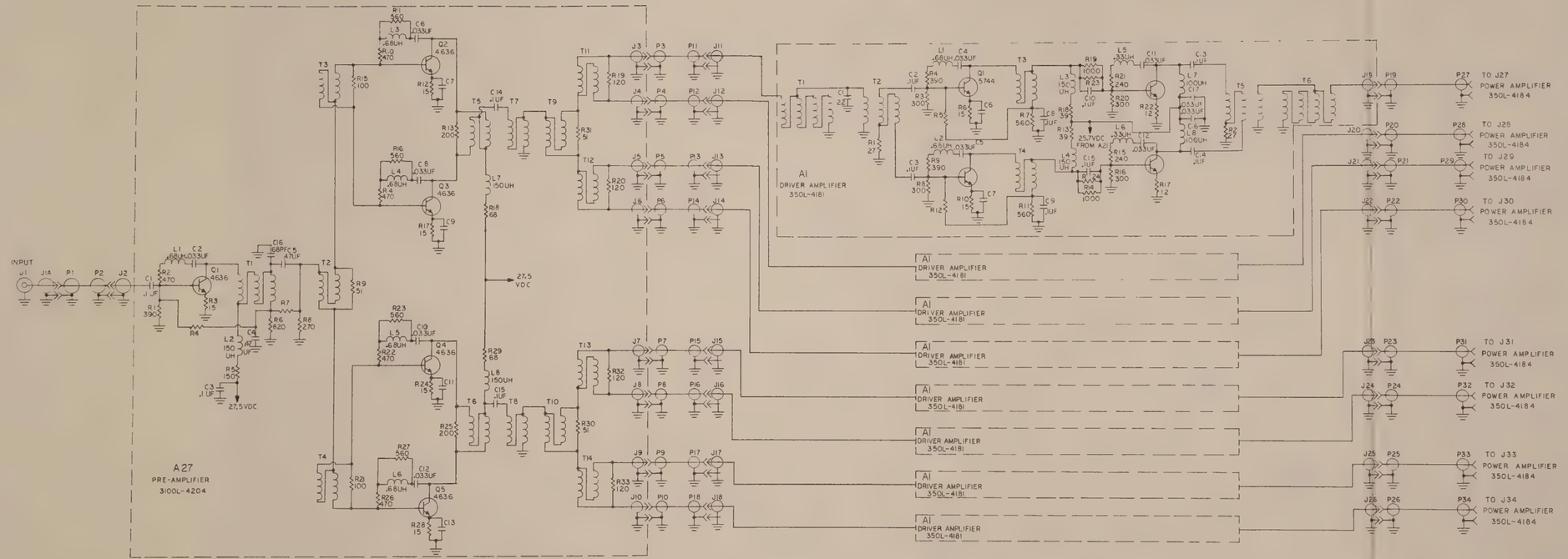
Table 7-1 provides a listing of all electrical parts and those mechanical parts which may be required for replacement. Electrical parts are listed by module number and by reference designations as indicated on the schematic diagrams. Parts list includes a description, part number and manufacturers federal supply code number. Table 7-2 provides a reference glossary of abbreviations used in the parts list.

7.3 LIST OF MANUFACTURERS

Table 7-3 provides a correlation of the manufacturers federal supply code numbers used in the parts list with the names and addresses of the manufacturers. If ENI's manufacturer code number (10226) appears, that part must be obtained directly from Electronic Navigation Industries, Inc.

7.4 Ordering Replacement Parts

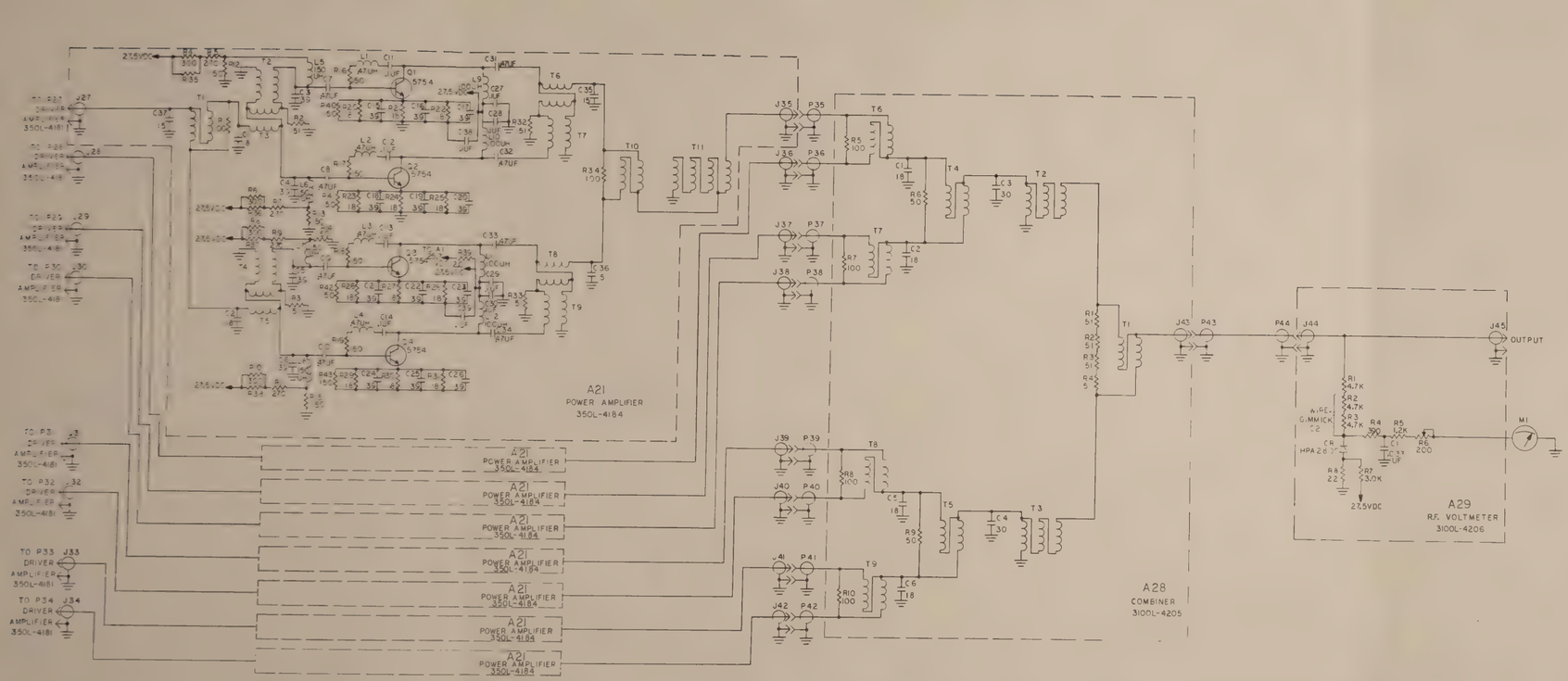
To obtain replacement parts, address order or inquiry to Electronic Navigation Industries, Inc. or its authorized service facility. Identify parts by number as listed in the parts list (Table 7-1).



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS.
2. DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE MARKED.
3. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE IN UUF.

Figure 7-1. Preamplifier and Driver Amplifier Section Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS.
2. DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE MARKED.
3. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE IN UUF.

Figure 7-2. Power Amplifier, Combiner and RF Voltmeter Section, Schematic Diagram

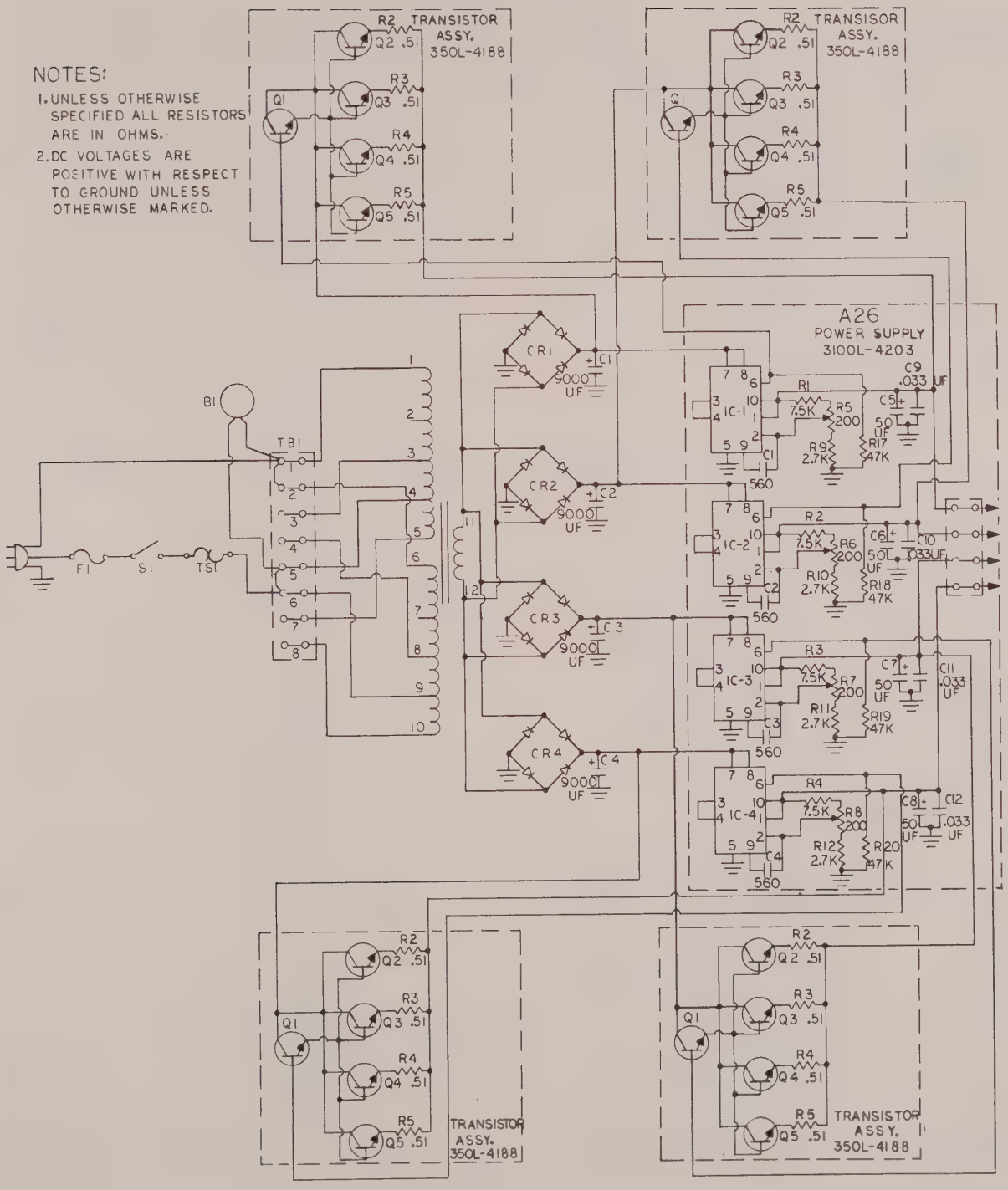


Figure 7-3. Power Supply Section, Schematic Diagram

Table 7-1. Replacement Parts List.

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
	CHASSIS MOUNTED PARTS (NO PREFIX):		
B1	Motor, Fan	82877	TN3A2
C1-C4	Capacitor, Elect. 9000UF 50 VDCW	56289	36D902G050BC2A
CR1-CR4	25A FW Bridge	04713	MDA990-2
DS1	Lamp 28 VDC -40MA	72619	101-8430-0931-201
F1	Fuse Type 3AG-15ASB	75915	313008
XF1	Fuse Holder	75915	342001
J1	Connector, Type N	13511	UG/606/U
J45	Connector, Type N	13511	UG/680/U
M1	Meter	32171	840-586
S1	Switch, 3/4 HP	31356	ST-42A(MS35058-9)
T1	Transformer, Power	12715	AM6205A
TB1	Terminal Block	71785	8-140
TS1	Thermostat	14604	2405-88-105
	TRANSISTOR ASSY. PARTS NO PREFIX: 4REQ.	10226	350L-4188
R2-R5	Resistor W.W. .5 ohm, 5%, 1/4 W	75042	BWH-.5
Q1	Transistor	79089	40312
Q2-Q5	Transistor	04713	2N3715
A26	POWER SUPPLY REGULATOR BOARD (A26)	10226	3100L-4203
A26 R1-R4	Res. Film 7.5K 5% 1/2 W	16299	HC5-7.5K
A26R5-R8	Pot, Vertical Mtg. 200 ohm	32997	3389T-1-201
A26R9-R12	Res. Film, 2.7K, 5%, 1/2 W	16299	HC5-2.7K
R26R17-R20	Res. COMP, 47K, 5%, 1/4 W	01121	RC07GF473J
A26C1-C4	Cap. Mica, 560pf, 5%	09023	CM06ED561J03
A26C5-C8	Cap. Elect. 50UF, 50 VDCW	56289	500D506G050DD7
A26C9-C12	Cap. 50V, 20%, .033UF	72982	8121-050-651-333M
A26IC-1-IC4	IC Regulator	49956	RC723CT
A26TB1	Terminal Block	71785	4-172
A27	PRE AMPLIFIER BOARD MODULE (27)	10226	3100L-4204
A27R1	Res. COMP. 390 ohm, 5%, 1/4 W	01121	RC07GF391J
A27R2	Res. COMP. 470 ohm, 5%, 1/2 W	01121	RC20GF471J
A27R3	Res. COMP. 15 ohm, 5%, 1/4 W	01121	RC07GF150J
A27R4	Res. COMP. Selected	01121	RC07
A27R5	Res. COMP. 150 ohm, 5%, 2W	01121	RC42GF151J
A27R6	Res. COMP. 820 ohm, 5%, 1/2 W	01121	RC20GF821J
A27R7	Res. COMP. Selected	01121	RC20
A28R8	Res. COMP. 270 ohm, 5%, 1/4 W	01121	RC07GF271J
A27R9	Res. COMP. 51 ohm, 5%, 1/4 W	01121	RC07GF510J
A27R10	Res. COMP. 470 ohm, 5%, 1/4 W	01121	RC07GF471J
A27R11	Res. COMP. 560 ohm, 5%, 1/4 W	01121	RC07GF561J
A27R12	Res. COMP. 18 ohm, 5%, 1/4 W	01121	RC07GF180J
A27R13	Res. COMP. 200 ohm, 5%, 1/2 W	01121	RC20GF201J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A27R14	Res. COMP. 470 ohm, 5%, 1/4 W	01121	RC07GF471J
A27R15	Res. COMP. 100 ohm, 5%, 1/4 W	01121	RC07GF101J
A27R16	Res. COMP. 560 ohm, 5%, 1/4 W	01121	RC07GF561J
A27R17	Res. COMP. 18 ohm, 5%, 1/4 W	01121	RC07GF180J
A27R18	Res. COMP. 68 ohm, 5%, 2 W	01121	RC42GF680J
A27R19, R20	Res. COMP. 120 ohm, 5%, 1/2 W	01121	RC20GF121J
A27R21	Res. COMP. 100 ohm, 5%, 1/4 W	01121	RC07GF101J
A27R22	Res. COMP. 470 ohm, 5%, 1/4 W	01121	RC07GF471J
A27R23	Res. COMP. 560 ohm, 5%, 1/4 W	01121	RC07GF561J
A27R24	Res. COMP. 18 ohm, 5%, 1/4 W	01121	RC07GF180J
A27R25	Res. COMP. 200 ohm, 5%, 1/2 W	01121	RC20GF201J
A27R26	Res. COMP. 470 ohm, 5%, 1/4 W	01121	RC07GF471J
A27R27	Res. COMP. 560 ohm, 5%, 1/4 W	01121	RC07GF561J
A27R28	Res. COMP. 18 ohm, 5%, 1/4 W	01121	RC07GF180J
A27R29	Res. COMP. 68 ohm, 5%, 2 W	01121	RC42GF680J
A27R30, R31	Res. COMP., 51 ohm, 5%, 1/2 W	01121	RC20GF510J
A27R32, R33	Res. COMP., 120 ohm, 5%, 1/2 W	01121	RC20GF121J
A27C1	Cap. Cer. 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A27C2	Cap, Cer. 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A27C3	Cap. Cer. 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A27C4, C5	Cap. Cer. 0.47UF, 50 VDCW	72982	8131-050-651-474Z
A27C6	Cap. Cer. 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A27C7	Cap, Mica, Selected	09023	CM05ED
A27C8	Cap. Cer. 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A28C9	Cap, Mica, Selected	09023	CM05ED
A27C10	Cap. Cer. 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A26C11	Cap. Mica, Selected	09023	CM05ED
A27C12	Cap. Cer. 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A2713	Cap. Mica, Selected	09023	CM05ED
A27C14	Cap. Cer. 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A27C16	Cap, Mica, 68pf 5%	09023	CM05ED680J03
A27L1	Choke, RF, 0.47UH, 10%	99800	MS18130-4
A27L2	Choke, RF, 150UH, 10%	99800	MS75052-7
A27L3-L6	Choke, RF, 0.47UH, 10%	99800	MS18130-4
A27L7, L8	Choke, RF, 150 UH, 10%	99800	MS75052-7
A27T1	Transformer	10226	
A27T2-T14	Transformer	10226	
A27Q1-Q5	Transistor, Sil, NPN	10226	4636
A1	DRIVER AMPLIFIER MODULE (A1) (8, PER UNIT)	10226	350L-4181
A1R1	Res., COMP. 27 ohm, 5%, 1/4 W	01121	RC07GF270J
A1R2	Res., COMP. 27 ohm, 5%, 1/2 W	01121	RC20GF270J
A1R3	Res., COMP. 300 ohm, 5%, 1/4 W	01121	RC07GF301J
A1R4	Res., COMP. 390 ohm, 5%, 1/4 W	01121	RC07GF391J
A1R5	Res., COMP. Selected	01121	RC07
A1R6	Res., COMP. 15 ohm, 5%, 1/4 W	01121	RC07GF150J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A1R7	Res., COMP. 560 ohm, 5%, 1 W	01121	RC32GF561J
A1R8	Res., COMP. 300 ohm, 5%, 1/4 W	01121	RC07GF301J
A1R9	Res., COMP. 390 ohm, 5%, 1/4 W	01121	RC07GF391J
A1R10	Res., COMP. 15 ohm, 5%, 1/4 W	01121	RC07GF150J
A1R11	Res., COMP. 560 ohm, 5%, 1 W	01121	RC32GF561J
A1R12	Res., COMP. Selected	01121	RC07
A1R13	Res., COMP., 39 ohm, 5%, 2 W	01121	RC42GF390J
A1R14	Res., COMP. 1K ohm, 5%, 1/2 W	01121	RC20GF102J
A1R15	Res., COMP. 240 ohm, 5%, 1/2 W	01121	RC20GF241J
A1R16	Res., COMP. 300 ohm, 5%, 1/4 W	01121	RC07GF301J
A1R17	Res., COMP. 12 ohm, 5%, 1/4 W	01121	RC42GF120J
A1R18	Res., COMP. 39 ohm, 5%, 2 W	01121	RC47GF390J
A1R19	Res., COMP. 1K ohm, 5%, 1/2 W	01121	RC20GF102J
A1R20	Res., COMP. 300 ohm, 5%, 1/4 W	01121	RC07GF301J
A1R21	Res., COMP. 240 ohm, 5%, 1/2 W	01121	RC20GF241J
A1R22	Res., COMP. 12 ohm 5%, 2 W	01121	RC42GF120J
A1R23, R24	Res., COMP. Selected	01121	RC07
A1C1	Cap. Mica, 22pf, 5%	09023	CM05ED220J03
A1C2, C3	Cap. Cer. 0.1UF 50 VDCW	72982	8121-050-651-104Z
A1C4, C5	Cap. Cer. 0.033UF 50 VDCW	72982	8121-050-651-333Z
A1C6, C7	NOT ASSIGNED		
A1C8-C10	Cap. Cer. 0.1UF 50 VDCW	72982	8121-050-651-104Z
A1C11, C12	Cap. Cer. 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A1C13-C15	Cap. Cer. 0.1UF 50 VDCW	72982	8121-050-651-104Z
A1C16, C17	Cap. Cer, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A1L1-L2	Choke, RF, 0.68UH, 10%	99800	MS18130-6
A1L3-L4	Choke, RF 150UH, 10%	99800	MS75052-7
A1L5-L6	Choke, RF, 0.33UH, 10%	99800	MS18130-3
A1L7-L8	Choke, RF, 100UH, 10%	99800	MS91189-37
A1T1	Transformer	10226	
A1T2	Transformer	10226	
A1T3, T4	Transformer	10226	
A1T6	Transformer	10226	
A1Q1-Q2	Transistor, Sil, NPN	10226	5754
A1Q3-Q4	Transistor, Sil, NPN	10226	3642
A21	POWER AMPLIFIER MODULE (A21) (8 PER UNIT)	10226	350L-4184
A21R1	Res., COMP, 100 ohm, 5%, 1/2 W	01121	RC20GF101J
A21, R2, R3	Res., COMP, 51 ohm, 5%, 1/2 W	01121	RC20GF510J
A21R4	Res., COMP, 300 ohm, 5%, 2 W	01121	RC42GF301J
A21R5	Res., COMP. Selected	01121	RC32
A21, R6	Res., COMP. 300 ohm, 5%, 2 W	01121	RC42GF301J
A21R7	Res., COMP. Selected	01121	RC32
A21R8	Res., COMP. 300 ohm, 5%, 2 W	01121	RC42GF301J
A21R9	Res., COMP. Selected	01121	RC32
A21R10	Res., COMP. 300 ohm, 5%, 2 W	01121	RC42GF301J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A21R11	Res., COMP. Selected	01121	RC32
A21R12-R15	Res., COMP. 150 ohm, 5%, 1/4 W	01121	RC07GF151J
A21R16-R19	Res., COMP. 150 ohm, 5%, 2 W	01121	RC42GF151J
A21R20-R31	Res., COMP. 18 ohm, 5%, 2 W	01121	RC42GF180J
A21R32-R33	Res., COMP. 51 ohm, 5%, 2 W	01121	RC42GF510J
A21R34	Res., COMP. 100 ohm, 5%, 2 W	01121	RC42GF101J
A21R35-R38	Res., COMP, Selected	01121	RC07
A21R39	Res. W. W. 2 ohm, 10% 2 W	75042	BWH-2
A21R40-43	Res., COMP. 150 ohm, 5%, 1/4 W	01121	RC07GF151J
A21C1, C2	Cap. Mica, 18pf, 5%	09023	CM05ED180J03
A21C3-C6	Cap. Mica, 39pf, 5%	09023	CM05ED390J03
A21C7-C10	Cap. Cer. 0.47UF, 50 VDCW	72982	8131-050-651-474Z
A21C11-C14	Cap. Cer. 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21C15-C26	Cap. Mica, 39pf, 5%	09023	CM05ED390J03
A21C27-C30	Cap. Cer. 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21C31-C34	Cap. Cer. 0.47UF, 50 VDCW	72982	8131-050-651-474Z
A21C35-C37	Cap. Mica, 15pf, 5%	09023	CM05ED150J03
A21C38-C39	Cap. Cer. 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21L1-L4	Choke, RF, 0.47UH, 10%	99800	MS18130-4
A21L5-L8	Choke, RF, 150UH, 10%	99800	MS75052-7
A21L9-L12	Choke, RF, 100UH, 10%	99800	MS91189-37
A21T1	Transformer	10226	
A21T2	Transformer	10226	
A21T3	Transformer	10226	
A21T4	Transformer	10226	
A21T5	Transformer	10226	
A21T6	Transformer	10226	
A21T7	Transformer	10226	
A21T8	Transformer	10226	
A21T9	Transformer	10226	
A21T10	Transformer	10226	
A21T11	Transformer	10226	
A21Q1-Q4	Transistor, Sil, NPN	10226	5754
A28	COMBINER MODULE (A28)	10226	3100L-4205
A28R1-R4	Res. W.W., 51 ohm, 5%, 2 W	01121	RC42GF510J
A28R5	Res. W. W., 100 ohm, 1%, 15 W	19647	MP312-100
A28R6	Res. W. W., 50 ohm, 1%, 15 W	19647	MP312-50
A28R7-R8	Res. W. W., 100 ohm, 1%, 15 W	19647	MP312-100
A28R9	Res. W. W., 50 ohm, 1%, 15 W	19647	MP312-50
A29R10	Res. W. W., 100 ohm, 1%, 15 W	19647	MP312-100
A28C1-C2	Cap, Mica, 18pf, 5%	09023	CM05ED180J03
A28C3-C4	Cap. Mica, Selected	09023	CM05
A28C5-C6	Cap. Mica, 18pf, 5%	09023	CM05ED180J03
A28T1	Transformer	10226	
A28T2-T3	Transformer	10226	
A28T4-T9	Transformer	10226	

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A29	RF VOLTMETER MODULE (A29)	10226	3100L-4206
A29R1-R3	Res. COMP. 4.7K ohm, 5%, 1/2 W	75042	RC20GF472J
A29R4	Res. COMP. 390 ohm, 5%, 1/4 W	01121	RC07GF391J
A29R5	Res. COMP. 1.2K ohm, 5%, 1/4 W	01121	RC07GF122J
A29R6	Pot. Vertical Mtg. 200 ohm	32997	3389T-1-201
A29R7	Res. COMP. 3K ohm, 5%, 1/4 W	01121	RC07GF302J
A29 R8	Res. COMP. 22 ohm, 5%, 1/4 W	01121	RC07GF220J
A29C1	Cap. Cer. 0.033UF; 50 VDCW	72982	8121-050-651-333Z
A29CR1	Diode	28480	HPA-5082-2800

Table 7-2. Glossary of Abbreviations

AMP	AMPERES	MTG	MOUNTING
AMPL	AMPLIFIER	PF	PICOFARAD
BKT	BRACKET	POT	POTENTIOMETER
CAP	CAPACITOR	REF	REFERENCE
CER	CERAMIC	RES	RESISTOR
COMP	COMPOSITION CARBON	SIL	SILICON
		UF	MICROFARADS
DPDT	DOUBLE-POLE DOUBLE THROW	V	VOLTS
		VAR	VARIABLE
IN	INCHES	VDCW	DC WORKING VOLTS
K	KILOHMS	W	WATTS
UH	MICROHENRY	WW	WIRE WOUND
MW	MILLIWATTS		

Table 7-3. List of Manufacturers.

FEDERAL SUPPLY CODE NUMBER	MANUFACTURER	ADDRESS
01121	Allen-Bradley Co.	Milwaukee, WI.
04713	Motorola, Inc. Semiconductor Prod. Div.	Phoenix, AZ.
09023	Cornell-Dubilier Electronics	Sanford, N.C.
10226	ELECTRONIC NAVIGATION INDUSTRIES, INC.	Rochester, N.Y.
12715	American Magnetics Corp.	Carterville, IL.
13511	Amphenol Corp. Inc.	Los Gatos, CA.
14604	Elmwood Sensors, Inc.	Cranston, R.I.
16299	Corning Glass	Raleigh, N. C.
19647	Caddock Electronics, Inc.	Riverside, CA.
22753	U I D Electronics Corp.	Hollywood, FL.
28480	Hewlett Packard Co.	Palo Alto, CA.
31356	J-B-T Instruments Inc.	New Haven, CT.
32171	Modutec, Inc.	Norwalk, CT.
32997	Bourns, Inc.	Riverside, CA.
49956	Raytheon Co.	Lexington, MA.
56289	Sprague Electric Co.	N. Adams, MA.
71785	Cinch Mfg. Co.	Elk Grove Village, IL.
72619	Dialight Corp.	Brooklyn, N.Y.
72982	Erie Technological Products, Inc.	Erie, PA.
75042	I R C Div. of TRW Inc.	Philadelphia, PA.
75915	Littlefuse, Inc.	Des Plaines, IL.
79089	R C A	Harrison, N. Y.
82877	Rotron, Inc.	Woodstock, N. Y.
99800	Delevan Electronics Corp.	E. Aurora, N. Y.

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